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REDUCTION IN STRESS OF SPUR GEAR BY APPLYING STRESS RELIEVING FEATURES WITH VARIANT SHAPE, SIZE AND LOCATION

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ABSTRACT: *Gear drive is used to transmit power between two shafts when distance between them is very small. It maintains the stable velocity ratio without slip.It is observed that gears are the most effective by means of transmitting power due to their high degree of reliability and compactness. The cost of replacement of gear is very high and also the system down time is one of the effective factors. Failure of gear due to high stresses developed which leads to breakdown of system.*
To avoid failure stresses should be minimized at maximum stress concentrated area. Stress occurs during its actual working. These stresses can be minimized by introducing stress relief features at stress zone.
In this direction of research work, various stress relieving features were studied. Single or more circular and ovalshape. Also combination of circular and elliptical shape was used to study the effect of these features in stress reduction. Here effect of 'Single Aero-fin shape and in combination with other geometrical shapes' will studied.

I. INTRODUCTION

Gears are used for a wide range of industrial applications. They are the most common by means of transmitting power. They are optimal medium for low energy loss and high accuracy.

Gears are used to transmit the power with high velocity ratio. During this phase, they face high stress at the point of contact. A pair of teeth in action is generally subjected to two types of cyclic stresses.

i) Bending stresses inducing bending fatigue.

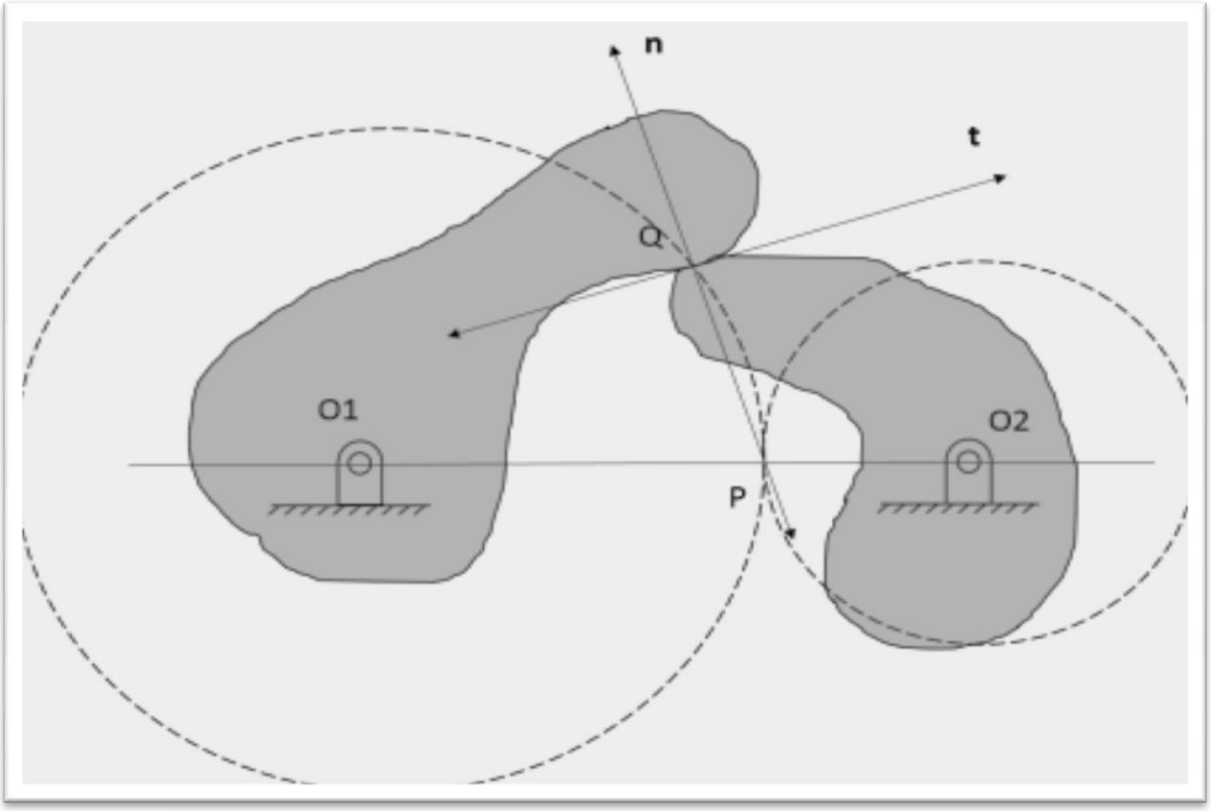
ii) Contact stress causing contact fatigue.

Types of Gears

According to position of axes of the shaft

- Parallel Type
  - ❖ Spur
  - ❖ Helical
  - ❖ Rack and Pinion

- Non intersecting Type



- Intersecting Type

- ❖ Bevel Gear
- ❖ Worm and Worm Wheel

Fundamental Law of Gearing

The condition to maintain a constant angular velocity ratio between pair of gears is that the common normal at the point of contact should meet the line joining the centers at a fixed point.

II. LITERATURE REVIEW

G. S. Schajer(1)Finite element analysis can successfully be applied in association with measurements of residual stress. Experimental calibration for complex geometry shapes as a SRF has previously been employed, but this is time consuming.

Mr. Sujit R. Gavhane (2)In this paper stress relieving features for spur gear have been studied with single stress relieving technique by using FEA. Results of this study provide how to minimize stresses developed in spur gear.

Dhavale A.S.(3)Stress reduction by means of single stress reliving features did not improve gear stress. Stress reduction is highly sensitive to the change in size, location and number so select size. Small variation in size, location and number gives large difference in equivalent stress. Introduction of stress reliving feature at specific location of specific size and number gives maximum reliving of stress.

Mahesh Badithe (4)The main aim of the above study is to relieve stress from the maximum value. So the highest point of contact of teeth with highest stress is selected as pressure application point. Stress relieving feature having a shape of aero-fin is used in the path of stress flow which helped to regulate stress flow by redistributing the lines of force. This also yielded better results when compared to elliptical and circular holes.

Scope for further work:

- ✓ Some more positions of the aero-fin shape can be experimented.
- ✓ This can be extended toBi-directionalgears.

Nidal ABU- HAMDEH (5)A model for simulation was used to check the effect of creating holes in the gear body as stress relieving features. The model was performed by creating holes in the gear body with various diameters, various center distances from Z-axis. Furthermore, changing the diameter of holes resulted in higher percentage of stress reductions.

Prof. S.B.Naik (6)Following things can be concluded from the above work.

- ✓ Very less reduction in stress is possible with single circular hole.
- ✓ Two circular holes as a stress relieving feature give more reduction than single circular hole.
- ✓ Stress zones are very much sensitive to the location & size of stress relieving features.

DeepikaPotghan (7)This paper is to travel in the direction towards relieve stress from the maximum value to as minimum as possible from gear.Stress relieving feature having the shapes of circular, elliptical and aero- fin were used individually in the path of stress flow which helped to regulate stress flow by redistributing the lines of force.After compare results SRF having the shape of aero- fin yielded better results when compared to other shapes. More effective result will obtain by use of different shapes combination as a SRF.

Sarfraz Ali N. Quadri (8)This study mainly focuses on to reduce concentration of stresses in a gear tooth and body. The stresses are calculated analytically using Lewis formulae associated with finite element method. The results from both the methods have a slight percentage of difference. The effect of stress reliving features on the stresses is determined using finite element analysis.

5 locations are selected across the tooth geometry which is analyzed for two different sizes of the stress relieving features. The best location of stress reliving feature and best size is find out after comparing stress analysis at all the pre-selected locations and sizes.

L. Fredette (9)The data presented in this paper shows a sample of the effects that size of SRF and location hassensibly impact on critical gear parameters. However, several beneficial locations were isolated. Reduction in tensile stress at the tooth root of 8.8% was achieved with a single SRF. Stress redistribution was produced with a SRF combination which reduced the tooth surface stress 15.8%.

AbhijitMahadevSankpal (10)Theresults found by FEM are nearly equal to results found by experimental method. The module is important geometrical parameter during the design of gear. Therefore selection of proper module size is an important factor before designing gear. As maximum contact stress is inversely proportional to module.

Pratik Maheshwari (11)As from analysis stress reduction by means of introducing stress reliving feature is possible. The redistribution is highly sensitive to the change in size of the SRF. A careful selection of more than one location for introducing stress relieving feature is more beneficial instead choosing only one.

Stress reduction was done by means of introducing circular stress reliving features are found to be better. The circular stress relief feature have better control over changing the stress redistribution pattern without affecting the functioning of the gear.

M. S. Hebbal (12)From the paper study the following points were concluded.The elliptical Stress Relief Feature (SRF) can reduce the stress field better than the circular SRF. Since the elliptical SRF have more parameters to amplify the redistribution of the stress field constructively.

Prof. Vijay KumarChalwa (13)Conclusion & Future Scope after study of paper is as follows.

- ✓ Introduction of stress relieving features can be implemented without affecting the functionality of the existing gear systems.
- ✓ Small reduction in root fillet stress results in large increase in fatigue life of gear.
- ✓ It is possible to forecast the ratio of reduction in root fillet stress with a maximum deviation of 2%.
- ✓ The system can be employed to improve further even on gears in which the stress reductions are previouslyachieved by altering nonfunctional portion of the tooth profile.
- ✓ The method can be prolonged for the fatigue examination of gear. The relative study can also be done by usingthree dimensional models and two dimensional models.
- ✓ The technique presented here can be extended for the analysis of other gear types.

M. Pramod Reddy (14)It is concluded from the sensitivity studies of keeping the hole along the profile of the tooth the choice of the size and location of the circular groove is not a simple process, due to the nonlinear variations in a complex geometry. Different shapes of holes can also be studied for relieving stress.

M. S. Hebbal (15)Thehugecommon of the data points with single stress reliving features tried did not improve gear stresses. Rather it showed the movements across the whole gear face and work out the effect of the holes on gear stresses.

The relocation is highly delicate to the change in size of the stress relieving feature. A cautious selection of more than one location for introducing stress relieving feature is more advantageous than choosing only one. Stress drops by means of presenting stress reliving features with a grouping of elliptical and circular holes are found to be better. The elliptical stress relief feature have superiorregulator over changing the stress redistribution pattern.

ManojHariharan (16)Theextreme load on the pinion is at the point of prevalent single tooth contact point. The most acute design is for a gear ratio of 1:1. The introduction of a circular groove on the dedendum circle reduces the stress levels by a very high proportion with a small loss of rigidity of the tooth. This decodes into an exponential rise in the life of the gear due to a better location of various geometrical shapes.

Deep Singh Vishwakarma (17)The main objective of the above study is to relieve stress from the maximum value to as least as could be permissible. Stress relieving feature having a shape of oval is cast-off in the path of stress flow which helped to standardize stress flow by reallocating the lines of force. This additionally generated better results when compared to other SRF shapes.

Mr. AnandKalani (18)By presenting the circular stress relieving feature below dedendum the stress examination shows the root fillet have lesser tensile stress than the trailing root fillet which have larger compressive stress. It is determined from the stress investigation that the hole at involuteprofile will introduce more stress than the hole under the dedendum which leads to upsurge in tooth lifespan and so the lifecycle of whole gear.

V.Rajaprabakaran (19)Thekey objective of this learning is to add various shaped holes to decrease stress concentration. A finite element model of spur gear with a division of three teeth is considered for analysis and stress concentration reducing holes of several sizes are familiarized on gear teeth at a number of locations. Analysis shown that aero-fin shaped hole introduced along the stress flow direction yielded better results.

Nidal H. Abu-Hamdeh(20)The study evaluation focuses on the performance of one and more number of circular holes as a SRF. Effectiveness of more number of holes has great control on stress release than singular hole. Scope for various size, shape and location with the various grouping of geometrical shape can implement for advanceexamination.

Yasir Afzal (21)This paper defines Stress drop analysis of a Spur gear.The main objective of this study is to add round shaped SRF to reduce stress attention. In the paper Static analysis of a 3-D model had been achieved by using Inventor. Analysis revealed that round shaped hole introduced along the stress flow direction returnedimprovedoutcomes.

III. CONCLUSIONAFTER OBSERVATION

After reviewing research papers and thesis reports for the significant topic I will found research gap as below.

- ✓ Carrying out with arrangement of aero fin and various shapes as a SRF.
- ✓ After putting into practice above, learning influence on gear parameters.

IV. FUTURE WORK

I will effort ahead in the path towards to do few trials with the help of design examination software with change in shape, size, location and combination of two SRF and its effect on gear parameters. Main impartial is to minimize the stress value without disturbing working factors of spur gear.

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